

CLAIMS:

1. A wavelength-division multiple access system having a center apparatus (OLT), n optical network units (ONU), and m ONUs arranged via a wavelength multi/demultiplex apparatus, the OLT and the wavelength multi/demultiplex apparatus being connected together in a multiplex section via multiplex section optical fibers, the wavelength multi/demultiplex apparatus and the ONUs being connected together in an access section via access section optical fibers, downlink optical signals from the OLT to the ONUs and uplink optical signals from the ONUs to the OLT being transmitted through the multiplex section using wavelengths assigned to the respective ONUs while multiplexing the wavelengths, the wavelength multi/demultiplex apparatus carrying out wavelength multiplexing or demultiplexing for bidirectional transmissions,
- characterized in that a wavelength band  $D_a$  (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn}$ ) for downlink optical signals corresponding to the n ONUs, a wavelength band  $U_a$  (wavelengths  $\lambda_{u1}$  to  $\lambda_{un}$ ) for uplink optical signals corresponding to the n ONUs, a wavelength band  $D_b$  (wavelengths  $\lambda_{dn+1}$  to  $\lambda_{dn+m}$ ) for downlink optical signals corresponding to the m ONUs, and a wavelength band  $U_b$  (wavelengths  $\lambda_{un+1}$  to  $\lambda_{un+m}$ ) for uplink optical

signals corresponding to the  $m$  ONUs are set different from one another, the wavelength bands  $U_a$  and  $U_b$  are set adjacent to each other, and the wavelength bands  $U_a$  and  $D_a$  or the wavelength bands  $U_b$  and  $D_b$  are set  
5 adjacent to each other, and

each of the ONUs comprises:

downlink optical signal receiving means for receiving a downlink optical signal of one of the wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$  in the wavelength bands  $D_a$  and  
10  $D_b$  which wavelength is assigned to the ONU; and

uplink optical signal transmitting means for transmitting an uplink optical signal of one of the wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$  in the wavelength bands  $U_a$  and  $U_b$  which wavelength is assigned to the ONU or an  
15 uplink optical signal within a broad band including the wavelength bands  $U_a$  and  $U_b$ .

2. An optical wavelength-division multiple access system according to Claim 1, characterized in that the  
20 wavelength bands  $D_a$  and  $D_b$  for the downlink optical signals and the wavelength bands  $U_a$  and  $U_b$  for the uplink optical signals are set on the wavelength axis in order of the wavelength bands  $D_a$ ,  $U_a$ ,  $U_b$ , and  $D_b$  or the wavelength bands  $D_b$ ,  $U_b$ ,  $U_a$ , and  $D_a$ .

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3. An optical wavelength-division multiple access system according to Claim 1, characterized in that the

wavelength bands Da and Db for the downlink optical signals and the wavelength bands Ua and Ub for the uplink optical signals are set on the wavelength axis in order of the wavelength bands Ua, Ub, Db, and Da or  
5 the wavelength bands Da, Db, Ub, and Ua.

4. An optical wavelength-division multiple access system according to Claim 1, characterized in that the wavelength bands Da and Db for the downlink optical  
10 signals and the wavelength bands Ua and Ub for the uplink optical signals are set on the wavelength axis in order of the wavelength bands Ub, Ua, Da, and Db or the wavelength bands Db, Da, Ua, and Ub.

15 5. An optical wavelength-division multiple access system according to Claim 1, characterized in that a connection is made to each ONU in the access section via two access section optical fibers,

the OLT is configured to multiplex the wavelengths  
20 of and transmits optical carriers for uplink signals in the wavelength bands Ua and Ub (wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$ ) and the downlink optical signals of the wavelength bands Da and Db (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$ ) to the multiplex section optical fiber,

25 the wavelength multi/demultiplex apparatus is configured to separate the optical carriers for uplink signals from the downlink optical signals, the optical

carriers for uplink signals and the downlink optical signals being input via the multiplex section optical fiber and having the wavelengths corresponding to the ONUs, to output the resultant signals to the ONUs via  
5 one of the access section optical fibers, and to multiplex the uplink optical signals input through the other access section optical fiber and having the wavelengths corresponding to the ONUs, to output the resultant signals to the multiplex section optical  
10 fiber, and

each of the ONUs comprises a wavelength band multiplexer which is characterized by separating the wavelength bands  $U_a$  and  $U_b$  for the uplink optical signals from the wavelength bands for the downlink  
15 optical signals and which separates an optical carrier for an uplink signal from a downlink optical signal, the optical carrier for the uplink signal and the downlink optical signal being input via the one of the access section optical fiber and having the  
20 wavelengths corresponding to the ONU, and an optical modulator which operates as the uplink optical signal transmitting means and which modulates the optical carrier for the uplink signal separated by the wavelength band demultiplexer and having the  
25 wavelength corresponding to the ONU to transmit the resultant signal to the other access section optical fiber.

6. An optical wavelength-division multiple access system according to Claim 1, characterized in that a connection is made to each ONU in the access section  
5 via one access section optical fiber,

each of the ONU comprises a wavelength band demultiplexer which is characterized by separating the wavelength bands  $U_a$  and  $U_b$  for the uplink optical signals from the wavelength bands for the downlink  
10 optical signals and which outputs, to the downlink optical signal receiving means, a downlink optical signal input via the access section optical fiber and having the wavelength corresponding to the ONU, the wavelength band demultiplexer outputting, to the  
15 access section optical fiber, an uplink optical signal output by the uplink optical signal transmitting means and having the wavelength corresponding to the ONU.

7. An optical network unit (ONU) used in a  
20 wavelength-division multiple access system having a center apparatus (OLT),  $n$  ONUs, and  $m$  ONUs arranged via a wavelength multi/demultiplex apparatus, the OLT and the wavelength multi/demultiplex apparatus being connected together in a multiplex section via a  
25 multiplex section optical fiber, the wavelength multi/demultiplex apparatus and the ONUs being connected together in an access section via an access

section optical fiber, downlink optical signals from the OLT to the ONUs and uplink optical signals from the ONUs to the OLT being transmitted through the multiplex section using wavelengths assigned to the  
5 respective ONUs while multiplexing the wavelengths, the wavelength multi/demultiplex apparatus carrying out wavelength multiplexing or demultiplexing for bidirectional transmissions,

characterized in that a wavelength band Da  
10 (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn}$ ) for downlink optical signals corresponding to the n ONUs, a wavelength band Ua (wavelengths  $\lambda_{u1}$  to  $\lambda_{un}$ ) for uplink optical signals corresponding to the n ONUs, a wavelength band Db (wavelengths  $\lambda_{dn+1}$  to  $\lambda_{dn+m}$ ) for downlink optical  
15 signals corresponding to the m ONUs, and a wavelength band Ub (wavelengths  $\lambda_{un+1}$  to  $\lambda_{un+m}$ ) for uplink optical signals corresponding to the m ONUs are set different from one another, the wavelength bands Ua and Ub are set adjacent to each other, and the wavelength bands  
20 Ua and Da or the wavelength bands Ub and Db are set adjacent to each other, and

each of the ONUs comprises:

downlink optical signal receiving means for receiving a downlink optical signal of one of the  
25 wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$  in the wavelength bands Da and Db which wavelength is assigned to the ONU; and  
uplink optical signal transmitting means for

transmitting an uplink optical signal of one of the wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$  in the wavelength bands  $U_a$  and  $U_b$  which wavelength is assigned to the ONU or an uplink optical signal within a broad band including  
5 the wavelength bands  $U_a$  and  $U_b$ .

8. An optical network unit (ONU) used in a wavelength-division multiple access system having a center apparatus (OLT),  $n$  ONUs, and  $m$  ONUs arranged  
10 via a wavelength multi/demultiplex apparatus, the OLT and the wavelength multi/demultiplex apparatus being connected together in a multiplex section via a multiplex section optical fiber, the wavelength multi/demultiplex apparatus and the ONUs being  
15 connected together in an access section via an access section optical fiber, downlink optical signals from the OLT to the ONUs and uplink optical signals from the ONUs to the OLT being transmitted through the multiplex section using wavelengths assigned to the  
20 respective ONUs while multiplexing the wavelengths, the wavelength multi/demultiplex apparatus carrying out wavelength multiplexing or demultiplexing for bidirectional transmissions,

characterized in that a wavelength band  $D_a$   
25 (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn}$ ) for downlink optical signals corresponding to the  $n$  ONUs, a wavelength band  $U_a$  (wavelengths  $\lambda_{u1}$  to  $\lambda_{un}$ ) for uplink optical signals

corresponding to the  $n$  ONUs, a wavelength band  $D_b$  (wavelengths  $\lambda_{dn+1}$  to  $\lambda_{dn+m}$ ) for downlink optical signals corresponding to the  $m$  ONUs, and a wavelength band  $U_b$  (wavelengths  $\lambda_{un+1}$  to  $\lambda_{un+m}$ ) for uplink optical signals corresponding to the  $m$  ONUs are set different from one another, the wavelength bands  $U_a$  and  $U_b$  are set adjacent to each other, and the wavelength bands  $U_a$  and  $D_a$  or the wavelength bands  $U_b$  and  $D_b$  are set adjacent to each other,

a connection is made to each ONU in the access section via two access section optical fibers,

the OLT is configured to multiplex the wavelengths of and transmit optical carriers for uplink signals in the wavelength bands  $U_a$  and  $U_b$  (wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$ ) and downlink optical signals in the wavelength bands  $D_a$  and  $D_b$  (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$ ) to the multiplex section optical fiber,

the wavelength multi/demultiplex apparatus is configured to separate the optical carriers for uplink signals and downlink optical signals of the wavelengths corresponding to the ONUs from the optical carriers for uplink signals and downlink optical signals input via the multiplex section optical fiber and to output the resultant signals to the ONUs via one of the access section optical fibers, while multiplexing the uplink optical signals input through the other access section optical fiber and having the



wavelengths corresponding to the ONUs to output the resultant signals to the multiplex section optical fiber, and

each of the ONUs comprises:

- 5 a wavelength band demultiplexer which is characterized by separating the wavelength bands  $U_a$  and  $U_b$  for uplink optical signals from the wavelength bands  $D_a$  and  $D_b$  for downlink optical signals and which demultiplexes the optical carrier for the uplink
- 10 signal from the downlink optical signal, the optical carrier for the uplink signal and the downlink optical signal being input via one of the access section optical fibers and having the wavelengths corresponding to the ONU;
- 15 downlink optical signal receiving means for receiving a downlink optical signal of one the wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$  in the wavelength bands  $D_a$  and  $D_b$  demultiplexed by the wavelength band demultiplexer which wavelength is assigned to the ONU; and
- 20 uplink optical signal transmitting means for consisting of an optical modulator modulating an optical carrier for an uplink signal of one of the wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$  in the wavelength bands  $U_a$  and  $U_b$  demultiplexed by the wavelength band demultiplexer
- 25 which wavelength is assigned to the ONU, the optical modulator then transmitting the resultant signal to the other access section optical fiber.

9. An optical network unit (ONU) used in a wavelength-division multiple access system having a center apparatus (OLT), n ONUs, and m ONUs arranged  
5 via a wavelength multi/demultiplex apparatus, the OLT and the wavelength multi/demultiplex apparatus being connected together in a multiplex section via a multiplex section optical fiber, the wavelength multi/demultiplex apparatus and the ONUs being  
10 connected together in an access section via an access section optical fiber, downlink optical signals from the OLT to the ONUs and uplink optical signals from the ONUs to the OLT being transmitted through the multiplex section using wavelengths assigned to the  
15 respective ONUs while multiplexing the wavelengths, the wavelength multi/demultiplex apparatus carrying out wavelength multiplexing or demultiplexing for bidirectional transmissions,

characterized in that a wavelength band  $D_a$   
20 (wavelengths  $\lambda_{d1}$  to  $\lambda_{dn}$ ) for downlink optical signals corresponding to the n ONUs, a wavelength band  $U_a$  (wavelengths  $\lambda_{u1}$  to  $\lambda_{un}$ ) for uplink optical signals corresponding to the n ONUs, a wavelength band  $D_b$  (wavelengths  $\lambda_{dn+1}$  to  $\lambda_{dn+m}$ ) for downlink optical  
25 signals corresponding to the m ONUs, and a wavelength band  $U_b$  (wavelengths  $\lambda_{un+1}$  to  $\lambda_{un+m}$ ) for uplink optical signals corresponding to the m ONUs are set different

from one another, the wavelength bands  $U_a$  and  $U_b$  are set adjacent to each other, and the wavelength bands  $U_a$  and  $D_a$  or the wavelength bands  $U_b$  and  $D_b$  are set adjacent to each other,

5        a connection is made to each ONU in the access section via one access section optical fiber, and each of the ONUs comprises:

      a wavelength band demultiplexer which is characterized by separating the wavelength bands  $U_a$  and  $U_b$  for uplink optical signals from the wavelength bands for downlink optical signals and which outputs a downlink optical signal input via the access section optical fiber and having the wavelength corresponding to the ONU, to downlink optical signal receiving means, 10 while outputting an uplink optical signal output by uplink optical signal transmitting means and having the wavelength corresponding to the ONU, to the access section optical fiber;

      downlink optical signal receiving means for 20 receiving a downlink optical signal of one of the wavelengths  $\lambda_{d1}$  to  $\lambda_{dn+m}$  in the wavelength bands  $D_a$  and  $D_b$  which wavelength is assigned to the ONU; and

      uplink optical signal transmitting means for transmitting an uplink optical signal of one of the 25 wavelengths  $\lambda_{u1}$  to  $\lambda_{un+m}$  in the wavelength bands  $U_a$  and  $U_b$  which wavelength is assigned to the ONU or an uplink optical signal within a broad band including

the wavelength bands Ua and Ub.